Automotive Lightweighting Materials

Strain Rate Characterization of Advanced High Strength Steels

Background

In order to reduce weight and increase performance and safety of automobiles, U.S. automakers are increasingly using new grades of Advanced High-Strength Steels (AHSS). These new materials are used in structural components that are designed to withstand and manage high forces during crash and in-service conditions. New developments in metallurgy and processing of AHSS, together with advances in computer modeling, require accurate material characterization and verified models in order to take full advantage of the materials' higher strength.

Researchers at the Oak Ridge National Laboratory (ORNL) took on the task of developing and conducting material- and component-level experiments for the characterization of the crashworthiness of AHSS.

Technology

New experiments and computer models were developed to investigate the progressive crush in AHSS. The off-axis plate bending experiments

Figure 1. Different modes of progressive crushing lead to different amounts of energy dissipation in impact. Crushed in TMAC with 4 m/s.

(shown in Figure 2) replicate loading conditions that occur during the progressive crush of tubular-shaped structures and has a simple setup to minimize complexity of the test.

In addition, ORNL has developed structural component experiments using new, velocity-controlled, high-speed hydraulic equipment. Components are crushed in different modes to investigate crush efficiency and to characterize material responses.

Status

These new experiments are used to improve and verify

Benefits

- New experiments are being developed for material crashworthiness characterization.

- Experiments are used for model validation and development of optimal designs.

- New methods and materials models will enable automotive designers to develop more efficient and safer designs more quickly.
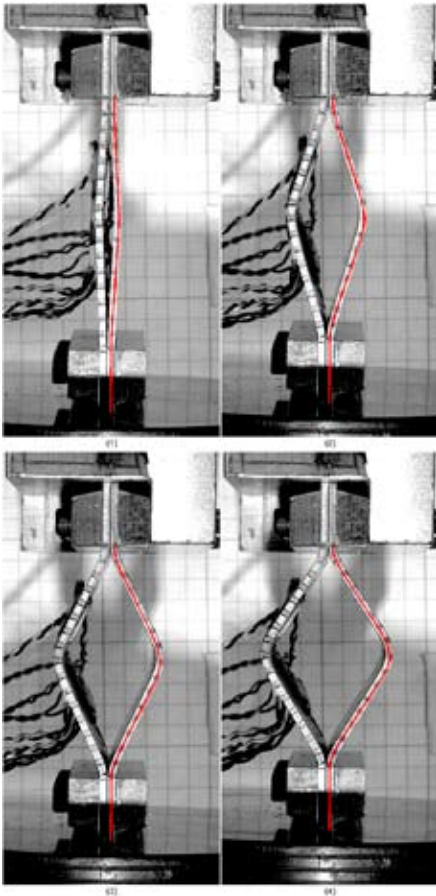
Figure 2. *Comparison of experiments and models (red) for double plate impact test.*

material models and computer modeling technologies for AHSS. Validated models will be distributed to steel manufacturers and automotive designers. New experimental setups and facilities are applied to new problems, such as modeling of strength of joints in impact, and further the advancement of crashworthy designs.

This particular effort has provided high-quality data for the development of material and structural computer models, enabling more accurate modeling and design of lightweight crashworthy vehicles.

Figure 3. *Test Machine for Automotive Crashworthiness (TMAC).*

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